J1939ECUSim GNU/LINUX

USER MANUAL

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1. Introduction

J1939ECUSim is a paid PC application which uses our CANMate device and CANMate API to implement J1939 compliant ECU simulation. This can be used to test devices like J1939 port readers without the need to connect to a vehicle. Using our J1939ECUSim along with the CANMate device can save 100s of dollars compared to stand alone hardware simulators which serve just the same purpose.

Features of J1939ECUSim

- Supports 5 variable and 6 fixed J1939 PGN's
- Message Logging
- J1939 DTC Support

Special cabling and power supply requirements. It can be used for testing J1939 devices and software.

1.1 Kit Contents

- J1939ECUSim Application
- a custom cable having OBD female connector at one end and 9 PIN Dsub connector at the other end and tap for providing 12V supply.

1.2 Application Installation

Installation instructions of J1939ECUSim in GNU/Linux .

- **Supported Platforms**

  Operating System : Ubuntu 14.04

  Kernel Version : 3.8

  Dependency : GTK3

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- **Install Instructions**
  - Download the ***J1939ECUSimv1.2.deb*** file
  - Install the deb file : **sudo dpkg -i J1939ECUSimv1.2.deb**
  - Issue the following commands :

    sudo chown <username>:<username> /usr/lib/libCANMATE.so

    sudo chown <username>:<username> /usr/bin/CANMate

    sudo chown -R <username>:<username> /usr/share/CANMate

The J1939ECUSim is listed in Accessories menu or you can run it from terminal by issuing the command "J1939ECUSim ".

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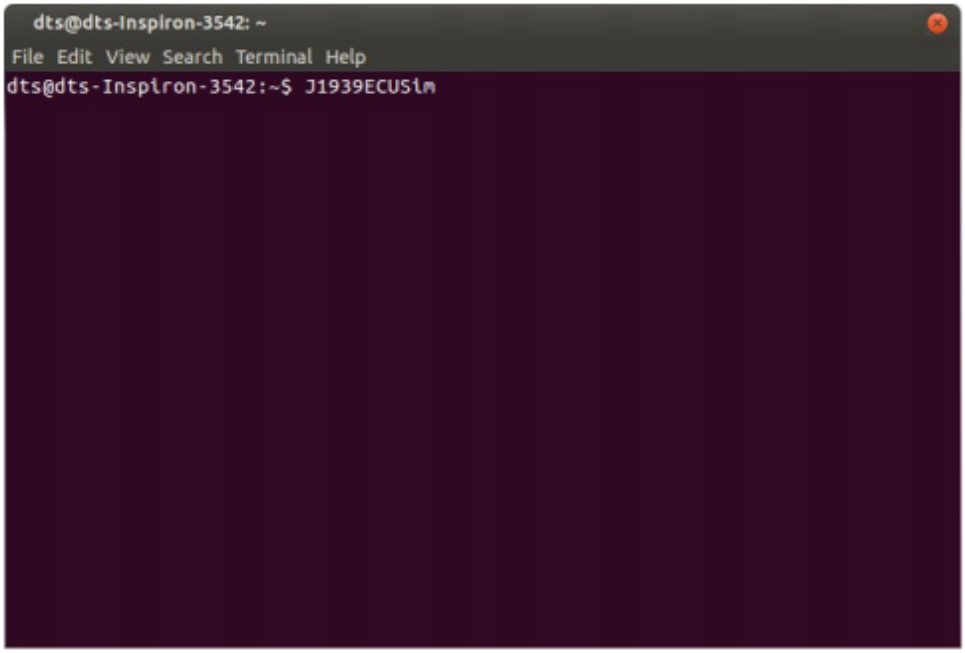
Running from terminal.



1.3 Connection Sequence

- Connect CANMate device to USB port of PC/laptop via USB cable.
- The red LED turns on to indicate that the device is powered up.
- Connect custom cable to the CANMate device.
- Connect 12V Power supply to the custom cable.
- Connect OBD port reader to the other end of custom cable.
- After connecting all devices, open the J1939ECUSim application.

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2. Getting Started

The screen-shot of the application is shown below.

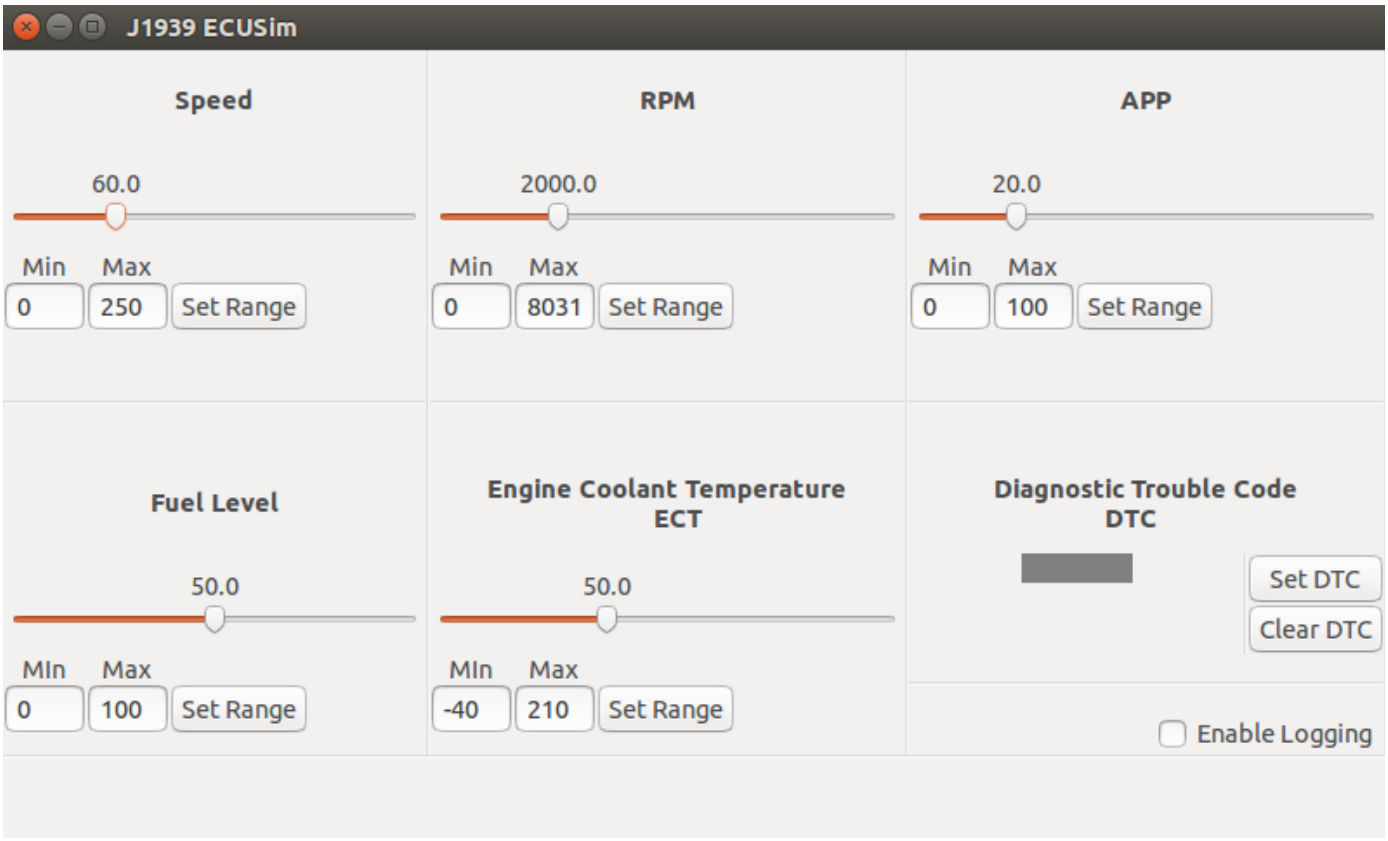

Figure2.1: J1939ECUSim Application

J1939ECUSim has the following capabilities:

- Set the range of the parameters using ***Set Range*** button.
- Change the value of the parameters using the Knob.
- Set the Diagnostic Trouble Code using ***Set DTC*** button.
- Clear the Diagnostic Trouble Code using ***Clear DTC*** button.
- The ***Enable Logging*** will save the communication details to J1939_ECUSIM.csv file in hex format. The csv file will be saved in the desktop.

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The **Set Range** is used to set the range of these parameters. It allows us to set the min and max values of parameters. The actual minimum and maximum values of the parameters are shown in the table below We can specify the values for each parameter only within this limit.

Note: Never set the min value below 'actual min value' and max value above 'actual max value'. If we select the invalid range a warning dialogue box will appear as shown below.

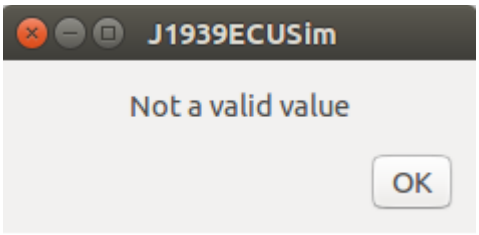

Figure2.2: Set range error

Each parameter has certain range as shown below:

Parameter	Min	Max
Speed	0	250
RPM	0	8031
APP	0	100
Fuel Level	0	100
ECT	-40	210

Table 2.1.Parameter Table

The function of **Set DTC** is to set Diagnostic Trouble Code /fault code. DTC(SAEJ1939-73) is made up of 4 elements -

- Suspect Parameter Number (SPN) 19 bits
- Failure Mode Identifier (FMI) 5 bits
- Occurrence Count (OC) 7 bits
- SPN Conversion Method (CM) 1 bit

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We support only one Suspect Parameter Number 1208 with FMI(Failure Mode Identifier) 3 [*Pre Filter Oil Pressure Sensor Circuit Failed High*]. The **clear DTC** will clear the trouble code.

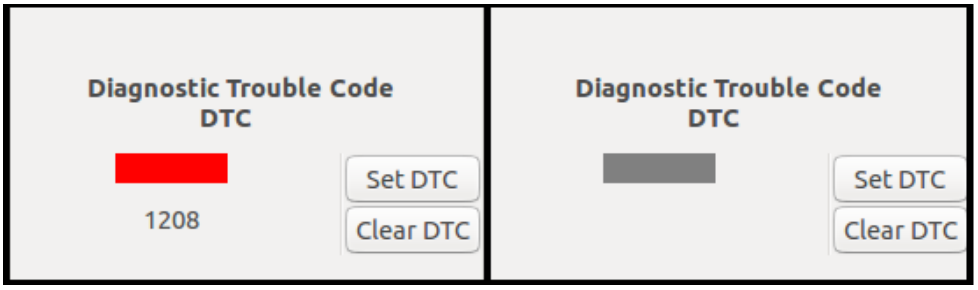

Figure 2.3: Setting and clearing DTC

By default, the J1939ECUSim App will not log the incoming and outgoing messages. Logging can be enabled by checking the ***"Enable Logging".*** All the incoming and outgoing messages will be logged into *J1939_ECUSimLog.csv* file.

A	B	C	D	E	F	G	H	I	J	K	L
#	ID	DLC	D0	D1	D2	D3	D4	D5	D6	D7	Type
1	CF00300	8	D1	32	32	FF	FF	1F	61	89	Tx
2	18FEEE00	8	5A	FF	FF	FF	FF	FF	FF	FF	Tx
3	18FEF100	8	FF	0	3C	FC	33	57	0	C0	Tx
4	CF00400	8	1E	7D	92	80	3E	0	4	92	Tx
5	18FEFC17	8	D1	7D	FF	FF	FF	FF	FF	FF	Tx
6	18FEF600	8	FF	1	4D	FF	FF	FF	FF	FF	Tx
7	18FEF500	8	C3	FF	FF	F9	23	FF	FF	FF	Tx
8	18FEF700	8	FF	FF	FF	FF	18	1	FF	FF	Tx
9	18FECA00	8	3	FF	0	0	0	0	0	0	Tx

Figure2.5 : J1939 Log

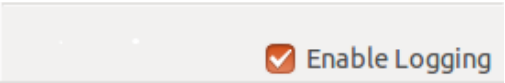

Figure2.4: Enable Logging

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3. Parameter Group Number Information

3.1 Variable PGNs

No.	Parameter	PGN
1	Vehicle Speed	65265
2	Engine RPM	61444
3	APP	61443
4	Fuel Level	65276
5	ECT	65262

3.1.1 Vehicle Speed

PGN 65265 ***Cruise Control/Vehicle Speed*** ***CCVS***

Transmission Repetition Rate: 100 ms
Data Length: 8
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 241 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65265 (0x00FEF1)

Start Position	Length	Parameter Name	SPN
1.1	2 bits	Two Speed Axle Switch	69
1.3	2 bits	Parking Brake Switch	70
1.5	2 bits	Cruise Control Pause Switch	1633
1.7	2 bits	Park Brake Release Inhibit Request	3807
2-3	2 bytes	Wheel-Based Vehicle Speed	84
4.1	2 bits	Cruise Control Active	595
4.3	2 bits	Cruise Control Enable Switch	596
4.5	2 bits	Brake Switch	597
4.7	2 bits	Clutch Switch	598
5.1	2 bits	Cruise Control Set Switch	599
5.3	2 bits	Cruise Control Coast (Decelerate) Switch	600
5.5	2 bits	Cruise Control Resume Switch	601
5.7	2 bits	Cruise Control Accelerate Switch	602
6	1 byte	Cruise Control Set Speed	86
7.1	5 bits	PTO Governor State	976
7.6	3 bits	Cruise Control States	527
8.1	2 bits	Engine Idle Increment Switch	968
8.3	2 bits	Engine Idle Decrement Switch	967
8.5	2 bits	Engine Test Mode Switch	966
8.7	2 bits	Engine Shutdown Override Switch	1237

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ECU Simulated parameter

Vehicle Speed : 0 – 250 [Variable with slider]

Resolution 1/256 km / h per bit

3.1.2 Engine RPM

PGN 61444 ***Electronic Engine Controller 1*** ***EEC1***

Engine related parameters

Transmission Repetition Rate:	engine speed dependent
Data Length:	8
Extended Data Page:	0
Data Page:	0
PDU Format:	240
PDU Specific:	4 PGN Supporting Information:
Default Priority:	3
Parameter Group Number:	61444 (0x00F004)

Start Position	Length	Parameter Name	SPN
1.1	4 bits	Engine Torque Mode	899
1.5	4 bits	Actual Engine - Percent Torque High Resolution	4154
2	1 byte	Driver's Demand Engine - Percent Torque	512
3	1 byte	Actual Engine - Percent Torque	513
4-5	2 bytes	Engine Speed	190
6	1 byte	Source Address of Controlling Device for Engine Control	1483
7.1	4 bits	Engine Starter Mode	1675
8	1 byte	Engine Demand – Percent Torque	2432

ECU Simulated parameter

RPM : 0 – 8031 [Variable with slider]

Resolution 0.125 rpm / bit

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3.1.3 APP

(R) PGN 61443 Electronic Engine Controller 2 EEC2

Identifies electronic engine control related parameters.

Transmission Repetition Rate:	50 ms		
Data Length:	8		
Extended Data Page:	0		
Data Page:	0		
PDU Format:	240		
PDU Specific:	3	PGN Supporting Information:	
Default Priority:	3		
Parameter Group Number:	61443 (0x00F003)		

Start Position	Length	Parameter Name	SPN
1.1	2 bits	Accelerator Pedal 1 Low Idle Switch	558
1.3	2 bits	Accelerator Pedal Kickdown Switch	559
1.5	2 bits	Road Speed Limit Status	1437
1.7	2 bits	Accelerator Pedal 2 Low Idle Switch	2970
2	1 byte	Accelerator Pedal Position 1	91
3	1 byte	Engine Percent Load At Current Speed	92
4	1 byte	Remote Accelerator Pedal Position	974
5	1 byte	Accelerator Pedal Position 2	29
6.1	2 bits	Vehicle Acceleration Rate Limit Status	2979
6.3	2 bits	Momentary Engine Maximum Power Enable Feedback	5021
7	1 byte	Actual Maximum Available Engine - Percent Torque	3357

ECU Simulated parameter

APP **:** 0 – 100 [Variable with slider]

Resolution 0.4 % / bit

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3.1.4 Fuel Level

PGN 65276 ***Dash Display*** ***DD***

Transmission Repetition Rate:	1s		
Data Length:	8		
Extended Data Page:	0		
Data Page:	0		
PDU Format:	254		
PDU Specific:	252	PGN Supporting Information:	
Default Priority:	6		
Parameter Group Number:	65276 (0x00FEFC)		

Start Position	Length	Parameter Name	SPN
1	1 byte	Washer Fluid Level	80
2	1 byte	Fuel Level 1	96
3	1 byte	Engine Fuel Filter Differential Pressure	95
4	1 byte	Engine Oil Filter Differential Pressure	99
5-6	2 bytes	Cargo Ambient Temperature	169
7	1 byte	Fuel Level 2	38

ECU Simulated parameter

Fuel Level **:** 0 – 100 [Variable with slider]

Resolution 0.4 % / bit

3.1.5 Engine Coolant Temperature

ECU Simulated parameter

ECT **:-** 40 – 210 [Variable with slider]

Resolution 1 deg C / bit

Offset -40 deg C

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PGN 65262 ***Engine Temperature 1*** ***ET1***

Transmission Repetition Rate:	1 s		
Data Length:	8		
Extended Data Page:	0		
Data Page:	0		
PDU Format:	254		
PDU Specific:	238	PGN Supporting Information:	
Default Priority:	6		
Parameter Group Number:	65262 (0x00FEEE)		

Start Position	Length	Parameter Name	SPN
1	1 byte	Engine Coolant Temperature	110
2	1 byte	Engine Fuel Temperature 1	174
3-4	2 bytes	Engine Oil Temperature 1	175
5-6	2 bytes	Engine Turbocharger Oil Temperature	176
7	1 byte	Engine Intercooler Temperature	52
8	1 byte	Engine Intercooler Thermostat Opening	1134

3.2 Fixed PGNs

No.	Parameter	PGN
1	Baro	65269
2	Ambient Air Temp	65269
3	MAP	65270
4	IMAN Temp	65270
5	BATT Volt	65271
6	Engine Load	61443

3.2.1 Baro and Ambient Air Temperature

ECU Simulated parameter

Baro (Barometric Pressure): 0 – 125 [Fixed Value - 0xC3]

Resolution 0.5 kPa / bit

Ambient Air Temp : -273 – 1734 [Fixed Value - 0xF923]

Resolution 0.03125 deg C / bit

Offset -273 deg C

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PGN 65269 ***Ambient Conditions*** ***AMB***

Transmission Repetition Rate:	1 s	
Data Length:	8	
Extended Data Page:	0	
Data Page:	0	
PDU Format:	254	
PDU Specific:	245	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65269 (0x00FEF5)	

Start Position	Length	Parameter Name	SPN
1	1 byte	Barometric Pressure	108
2-3	2 bytes	Cab Interior Temperature	170
4-5	2 bytes	Ambient Air Temperature	171
6	1 byte	Engine Air Inlet Temperature	172
7-8	2 bytes	Road Surface Temperature	79

3.2.2 MAP & IMAN Temp

PGN 65270 ***Inlet/Exhaust Conditions 1*** ***IC1***

Transmission Repetition Rate:	0.5 s	
Data Length:	8	
Extended Data Page:	0	
Data Page:	0	
PDU Format:	254	
PDU Specific:	246	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65270 (0x00FEF6)	

Start Position	Length	Parameter Name	SPN
1	1 byte	Engine Diesel Particulate Filter Inlet Pressure	81
2	1 byte	Engine Intake Manifold #1 Pressure	102
3	1 byte	Engine Intake Manifold 1 Temperature	105
4	1 byte	Engine Air Inlet Pressure	106
5	1 byte	Engine Air Filter 1 Differential Pressure	107
6-7	2 bytes	Engine Exhaust Gas Temperature	173
8	1 byte	Engine Coolant Filter Differential Pressure	112

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ECU Simulated parameter

MAP : 0 – 500 [Fixed Value - 0x01]

Resolution 2 kPa / bit

IMAN Temp : -40 – 210 [Fixed Value - 0x4D]

Resolution 1 deg C / bit

Offset -40 deg C

3.2.3 Battery Volt

PGN 65271 ***Vehicle Electrical Power 1*** ***VEP1***

Transmission Repetition Rate:	1 s	
Data Length:	8	
Extended Data Page:	0	
Data Page:	0	
PDU Format:	254	
PDU Specific:	247	PGN Supporting Information: See Appendix D - PGN 65104
Default Priority:	6	
Parameter Group Number:	65271 (0x00FEF7)	

Start Position	Length	Parameter Name	SPN
1	1 byte	Net Battery Current	114
2	1 byte	Alternator Current	115
3-4	2 bytes	Charging System Potential (Voltage)	167
5-6	2 bytes	Battery Potential / Power Input 1	168
7-8	2 bytes	Keyswitch Battery Potential	158

ECU Simulated parameter

Battery Volt : 0 – 3212 [Fixed Value -0x1801]

Resolution 0.05 V / bit

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3.2.4 Engine Load

The Parameter group number of Engine load is 61443. We get this value along with Accelerator Pedal position. [Refer Section3.1.3].

ECU Simulated Parameter

Engine Load : 0-250 [Fixed Value -0x32]

Resolution 1 % / bit

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4.ACTIVE DIAGNOSTIC TROUBLE CODES (DM1)

In SAE J1939, the acronym DTC stands for Diagnostic Trouble Code, also known as a fault code, and serves to identify the failed parameter. A DTC contains the Suspect Parameter Number (SPN) for the failed parameter, how many times failure has occurred (OC), and how it has failed (FMI).

Active DTCs are transmitted by the DM1 message while non-active DTCs (i.e. historic) are transmitted by the DM2 message. The DM1 and DM2 messages may contain multiple DTCs which mean the message may be transmitted using the Transport Protocol (TP). Both the DM1 and DM2 messages are defined by the J1939-73 specification.

The currently defined lamps (Malfunction Indicator Lamp, Red Stop Lamp, Amber Warning Lamp, and Protect Lamp) are associated with DTCs. If the transmitting electronic component does not have active DTCs, then the lamp status from that component will indicate that the lamps should be off.

Data Length:			Variable
Data page:			0
PDU Format:			254
PDU Specific:			202
Default Priority:			6
Parameter Group Number:			65,226 ($00FECA_{16}$)
Byte:	1	bits 8-7	Malfunction Indicator Lamp Status
		bits 6-5	Red Stop Lamp Status
		bits 4-3	Amber Warning Lamp Status
		bits 2-1	Protect Lamp Status
Byte:	2	bits 8-7	Reserved for SAE assignment Lamp Status
		bits 6-5	Reserved for SAE assignment Lamp Status
		bits 4-3	Reserved for SAE assignment Lamp Status
		bits 2-1	Reserved for SAE assignment Lamp Status
Byte:	4-3		SPN, 16 most significant bits
Byte:	5	bits 8-6	SPN, 3 least significant bits
		bits 5-1	FMI
Byte:	6	bit 8	Reserved for Future Assignment: This bit shall be sent as a one.
		bit 7-1	Occurrence Count

4.1DM1 message overview

Single packet (heart beat)

0x18 FE CA 00 1 Sec Transmitted as heart beat only if there are no active faults.

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Single packet (one defect is active)

0x18 FE CA 00 1 Sec Transmitted if there is only one active fault

4.2 DM1 transmission with no DTC

Byte 1	:	bits 8-7 = 00
		bits 6-5 = 00
		bits 4-3 = 00
		bits 2-1 = 11
Byte 2	:	bits 8-7 = 11
		bits 6-5 = 11
		bits 4-3 = 11
		bits 2-1 = 11
Byte 3 to byte 6	:	0 no SPN
Byte 7	:	0
Byte 8	:	0

4.3 DM1 transmission with DTC button pressed

SPN 1208 is generated

SPN 1208 = 0x4B8 = 000 00000100 10111000 (19 bits)

FMI 3 = 3 = 00011 (5 bits)

OC 10 = 0xA = 0001010 (7 bits)

CM = 0 = 0 (1 bit)

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Byte 1 : bits 8-7 = 01 (MIL LED on)

bits 6-5 = 00

bits 4-3 = 00

bits 2-1 = 11

Byte 2 : bits 8-7 = 11 (flashing not yet implemented)

bits 6-5 = 11

bits 4-3 = 11

bits 2-1 = 11

Byte 3 : 0xB8

Byte 4 : 0x04

Byte 5 : 0x03

Byte 6 : 0x8A

Byte 7 : 0xFF

Byte 8 : 0xFF

DTC																													
Byte 3 8 least significant bits of SPN (bit 8 most significant)								Byte 4 second byte of SPN (bit 8 most significant)								Byte 5 3 most significant bits of SPN and the FMI (bit 8 SPN msb and bit 5 FMI msb)								Byte 6							
SPN																		FMI					CM	OC						
8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
1	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	0

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4.4 DIAGNOSTIC DATA CLEAR /RESET FOR ACTIVE DTC'S (DM11)

All of the diagnostic information pertaining to the active diagnostic trouble codes should be erased. Sent as a request whenever the service tool wishes to clear/reset diagnostic data for active DTCs.

Transmission Rate	:	On request using PGN 59904
Data length	:	0
Extended data page	:	0
Data page	:	0
PDU Format	:	254
PDU Specific	:	211
Default priority	:	6
Parameter group number	:	65235 (0xFED3)

4.5 Diagnostic Readiness 1 (DM5)

Reports the diagnostics information that relates to diagnostic readiness.

Transmission Rate	:	On request using PGN 59904
Data Length	:	Variable
Extended Data Page	:	0
Data page	:	0
PDU Format	:	254
PDU Specific	:	206
Default Priority	:	6
Parameter Group Number	:	65230 (0xFECE)

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Byte:

1 : Active Trouble Codes

2 : Previously Active Diagnostic Trouble Codes

3 : OBD Compliance

4 : Continuously Monitored Systems Support/Status

6-5 : Non-continuously Monitored Systems Support

8-7 : Non-continuously Monitored Systems Status

ECU responds with byte 1 = number of DTC and byte 3 = 6 (EOBD)

All other parameter are set to 0xFF.

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4.6 Acknowledgment

Data length : 8 bytes

Extended Data Page : 0

Data Page : 0

PDU Format : 232

PDU Specific : Destination address = Global (255)

Default priority : 6

Parameter Group Number : 59392 (0xE800)

Byte

1 : Control byte = 0, Positive Acknowledgment (ACK)

2 : Group Function Value (If applicable)

3-4 : Reserved for assignment by SAE, these bytes should be filled with FF

5 : Address Acknowledged

6 : Parameter Group Number of requested information (8 LSB of parameter group number, bit 8 most significant)

7 : Parameter Group Number of requested information (2nd byte of parameter group number, bit 8 most significant)

8 : Parameter Group Number of requested information (8 MSBs of parameter group number, bit 8 most significant)

At request for not implemented DMs , simulator sends a NACK setting the control byte to 1. An Acknowledgment message is sent always to global address. Byte 5 in this response is originator source address. Group Function value is set to 0xFF.

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5. Testing J1939 Simulator

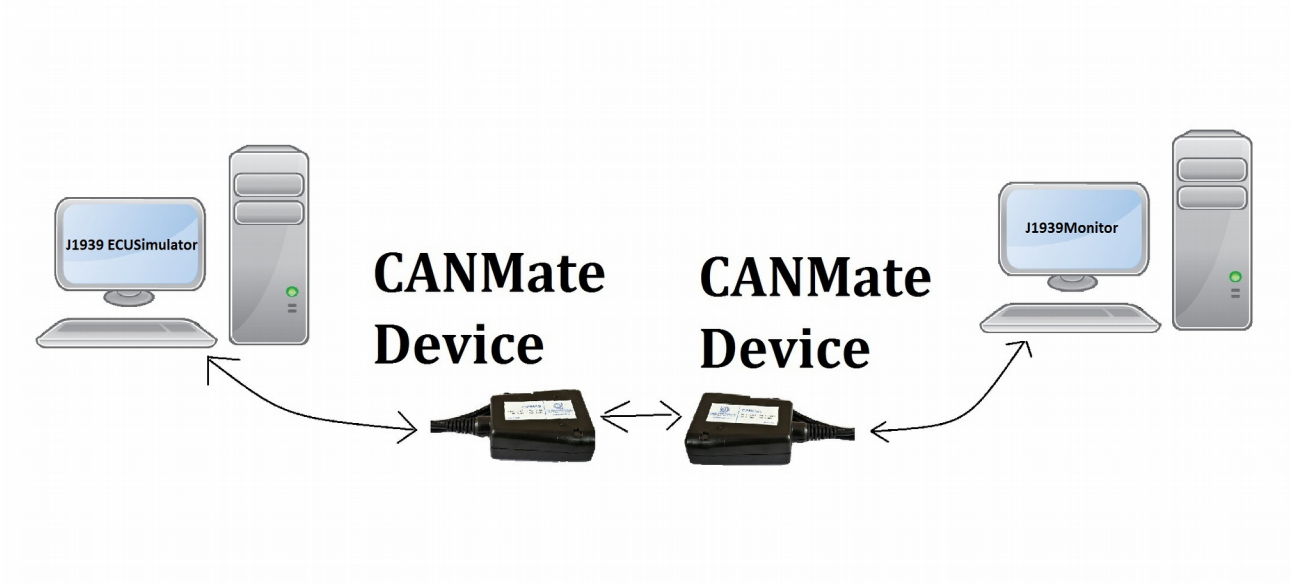

Figure5.1: Testing Simulator

Both J1939 Simulator application and J1939 Monitor application(Windows application) make use of CANMate device and CANMate API, thus here we need two PCs and two CANMate devices for testing.

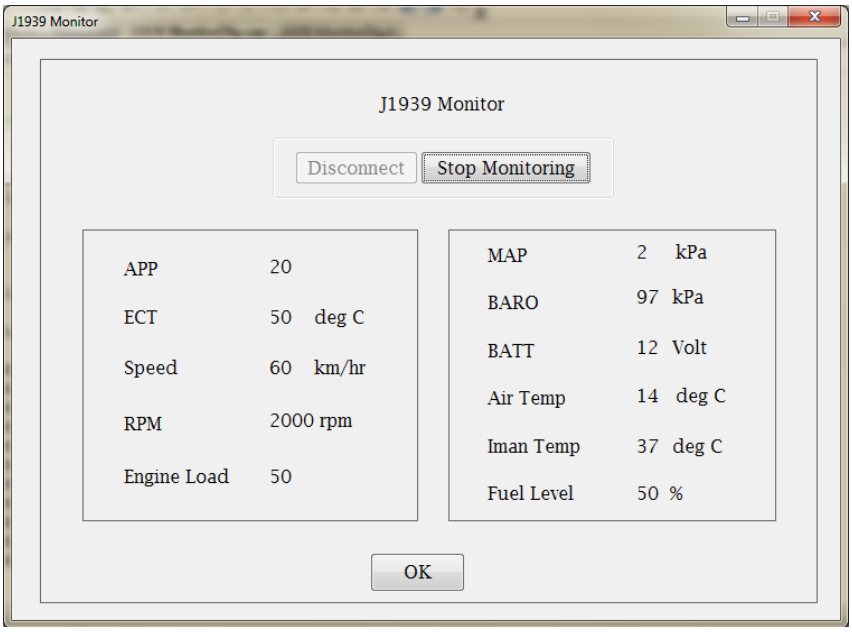

Figure5.2: J1939 Monitor

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- Connect CANMates on both PCs.
- Connect one CANMate to another CANMate.
- Run J1939 Monitor application on a PC.
  - Connect and start monitoring.
- Run J1939 Simulator application on another PC.
- Vary parameter values by adjusting the knobs.
- Monitor application will display these parameter values.

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6.Abbreviation

APP	Accelerator Pedal Position
CAN	Controller Area Network
DM	Diagnostic Message
DTC	Diagnostic Trouble Code
FMI	Failure Mode Identifier
IMAN	Intake Manifold Temperature
MAP	Manifold Absolute Pressure
MIL	Malfunction Indicator Lamp
OC	Occurrence Count
PGN	Parameter Group Number
SPN	Suspect Parameter Number

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